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Dreaming of Dreadbox Utopia

(Making of Breadboard Mock-U-topia)

— Project Notes —

O. Guy Morley

February 23, 2021

Introduction

Roberto very much enjoys making noises with his Roland SYSTEM-1m music synthesizer. He likes its "old school" analog feel (although it is internally digital) with three envelope generators, delayed LFO, a few effects, and pretty good sound. Being digital, the synth lets Roberto record all the internal states in the synth's memory and also in a computer. With the SYSTEM-1 soft synth (even expired trial version), Roberto can organize patches in a very flexible manner. When recalling a patch, he can even see the knob/slider/switch settings on the computer display.

In addition, the synth's polyphonic mode is useful to play chords and also when MIDI-controlling the synth for recording. A purely monophonic synth tends to generate clicks between MIDI notes due to sudden voltage changes. Roberto can avoid this with the polyphonic mode.

Yet another aspect of this synth is the availability of patching points. However, after experimenting with various self-patching options (and using DIY contraptions with only "passive" electronic components as written in another document), Roberto wanted do some more. For example, he wanted to connect the LFO out to GATE and CV. Now, LFO out is between -10v and +10v. In order to use this to control the CV in a meaningful way, the voltage needs to be manipulated, e.g., with an attenuinverter and offset generator. Then, the input voltage can be converted to any range between -10 and +10v.

Also, Roberto occasionally wanted to use both periodic and random forms of the LFO. With another LFO, even a simple one, he could use the onboard LFO for randomness and the extra one for periodic modulation.

Searching through the web,Roberto found a perfect little gadget to do these, called Utopia made by Dreadbox. It's a CV manipulator and also contains an LFO. More precisely, it has: 4x Attenuinverters, Offset Generator (+/- 10v), 4 to 3 Mixer, Voltage Controlled LFO, and Pulserizer. It seemed perfect ... except that Roberto didn't want to spend $99 for it and additional $79 for a power supply (e.g., Behringer CP1A High-Performance Power Supply).

So, Roberto decided to go cheap and started to think about a DIY option. And he sought a compromise between ease and practicality. So, he didn't try to replicate Utopia in full. He just implemented a few functions he needed.

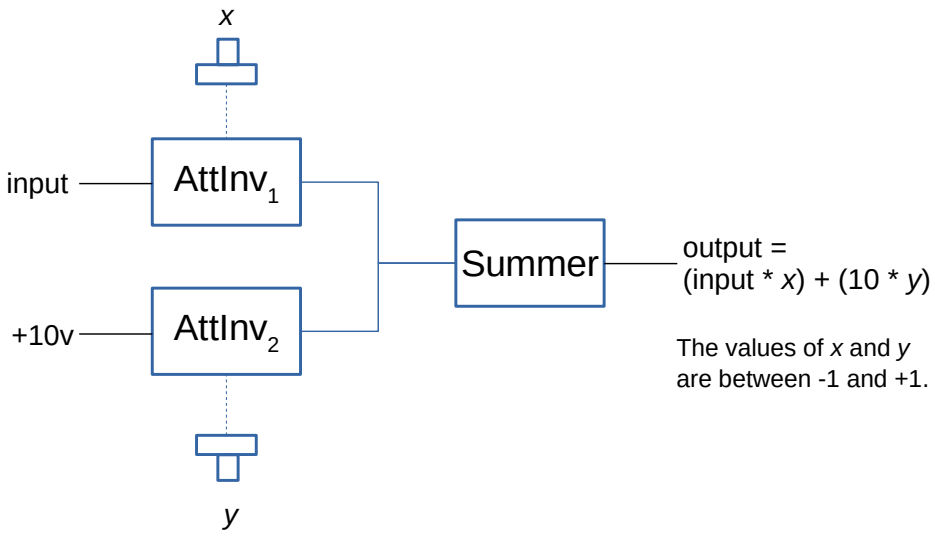
Disclaimer: Not responsible for potential negative consequences of using the information in this document.

Basic Ideas

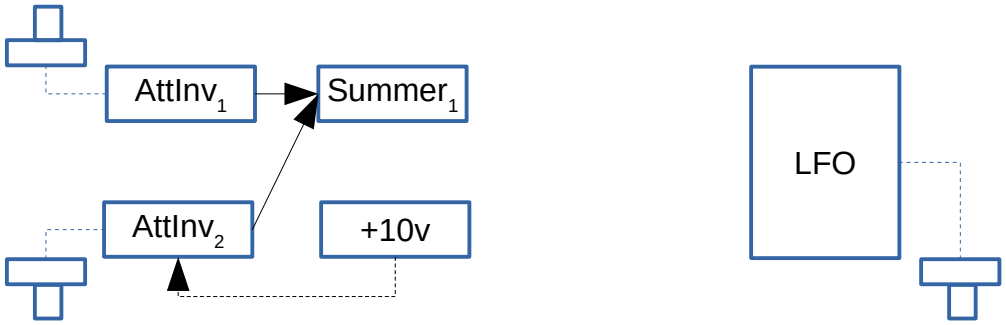
For this project, Roberto definitely needed to use OP Amps. He went on-line and identified simple circuit diagrams which he felt comfortable. Then, he decided on the minimal set of modules he wanted to implements.

- Attenuinverters (2)
- Summer
- +10v reference voltage
- LFO

The main idea here is to use the first three modules as in the following diagram.



Then, Roberto imagined the following layout for his tiny breadboard.

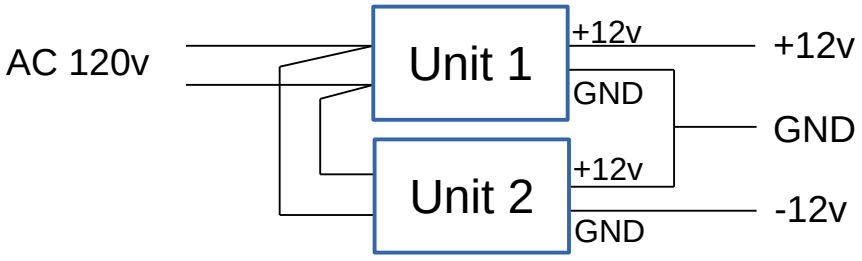


AttInv$_2$
Input normalized to +10v
works as offset generator

Components

First, Roberto needed a +/-12v power supply. But it was harder than he initially thought. He found an inexpensive item at Futurelec.com. However, there were some issues with order processing/shipping. Another possibility was Mean Well PD-2512 +/-12v switching power supply, carried by Mouser.com, etc. It seemed a good one but he wanted go cheaper than that. Eventually, Roberto settled for two 12v/1A switching power supply units with AC110-220v input (primarily used for LED lighting) from eBay.com (seller: speedlife2011).

Now, the two units can be connected as follows.

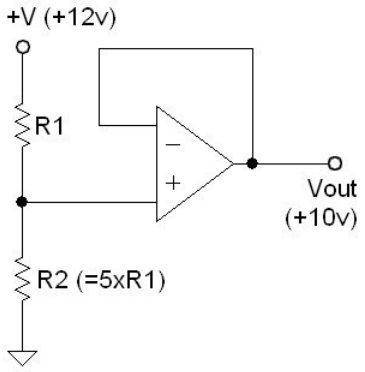


The actual items are shown below.

As for other components, Roberto happened to have an OP Amp, called LM324N. However, looking at the data sheet, its input is limited to -0.3 ~ 32v. Since he was planning to deal with the range between -10 and +10, this didn't seem right. So, he chose the classic (legacy?) LM1458N whose input is rated +/-15v. He got several of these from Mouser.com. He also bought a solderless breadboard with connection cables. Luckily, he already had an assortment of resistors, potentiometers, capacitors, etc. from past projects.

Reference Voltage (+10v)

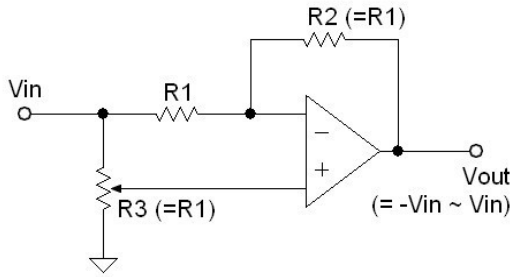
The first module Roberto made was to provide the reference voltage of +10v. Since the power supply is fairly stable and precision is not a priority, he used two resistors to divide +12v and buffered the output with an OP Amp.



The value of R1 can be any, as long as R1/R2 is 1/5. However, to avoid excessive current drain, Roberto chose R1 = 2kΩ and R2 = 10kΩ out of his limited stock of resistors. This will drain less than 1mA; so, that should be all right.

Attenuinverter/Offset Generator

Roberto browsed various OP Amp circuit examples on-line. Among these, he found one example particularly simple. It was found on the site of Kassutronics (https://kassu2000.blogspot.com/).

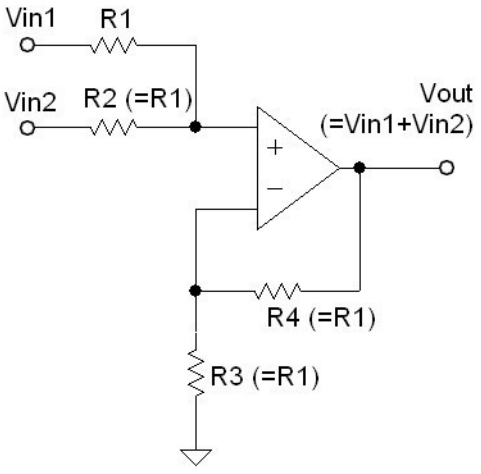


The value of R1 is arbitrary. For now, Roberto uses R1 = 2kΩ or 5kΩ. But he plans to change these to 10kΩ once he gets more resistors.

Kassutronics also discusses the option to make this module more "precise," around the polarity change point in the middle. Roberto may consider this in the future as well.

Summer

Next, Roberto needs to mix the signal from one attenuinverter and another (used as an offset generator). This can be done with a standard non-inverting amplifier circuit.

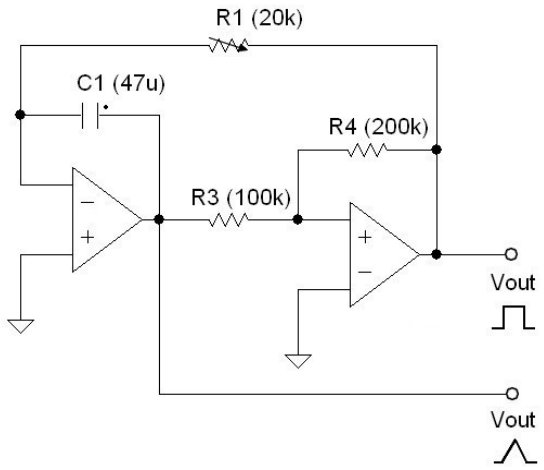


Note that the above circuit is good for only two inputs. If more than two inputs are added, the R3/R4 ratio must be recalculated. On the other hand, if we use a non-inverting

amplifier, it is possible to add multiple input voltages without such complication. However, the output must be inverted back to the input polarity.

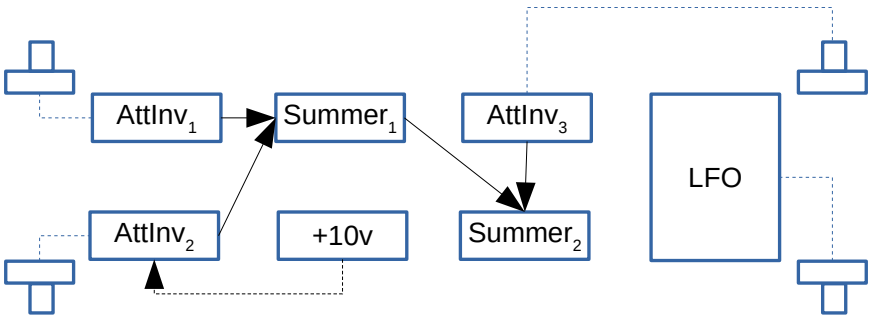
LFO

Roberto's choice of LFO circuit is also from Kassutronics. The values of R1 and C1 were adapted based on what he has.



Final Product

Including a few more components in the available space, Roberto fixed the layout as follows.



AttInv$_2$
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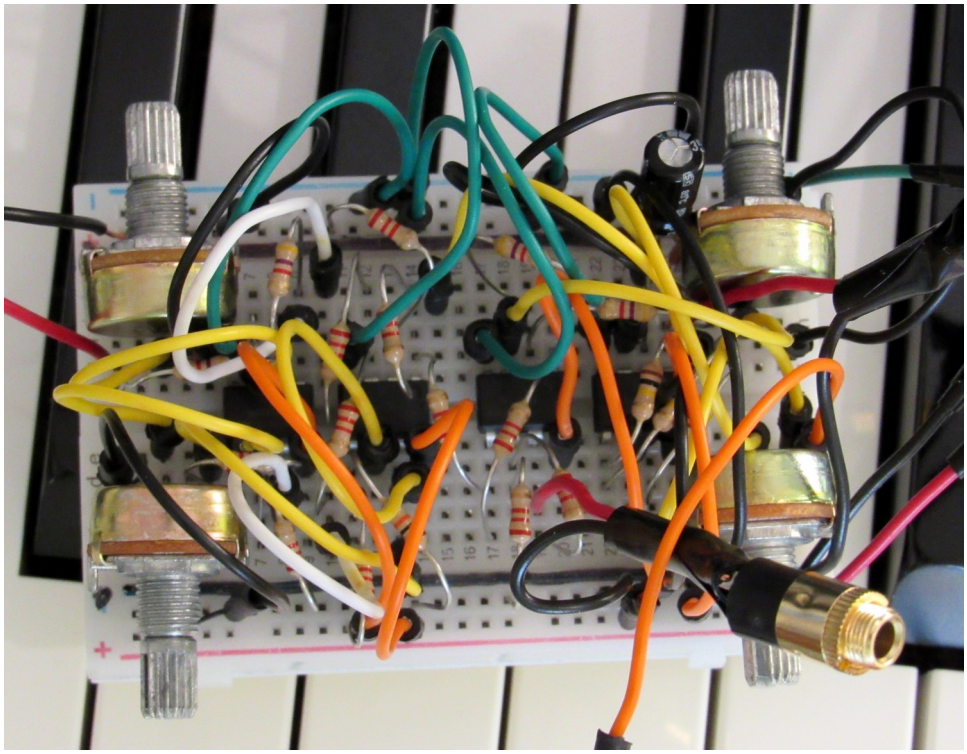
The actual image of the breadboard is as follows.



It is rather crammed. So, Roberto is planning to get a bigger breadboard and add some more components. For example, he wants to have 2 sets of attenuinverter+offset generator and 3 summers (comparable to the half of Tiptop Audio's MISO). He is also considering to implement a delay module and another module to extract the gate from the envelope.